

CRUISE RESULTS

CRUISE 1999-01

CHARTERED F/V's *DOMINATOR*, *MORNING STAR*, AND *VESTERAALEN* 1999 GULF OF ALASKA BIENNIAL GROUND FISH ASSESSMENT SURVEY MAY 10 - JULY 28, 1999

The first in the new series of biennial bottom trawl surveys of Gulf of Alaska (GOA) continental shelf and slope groundfish resources was conducted from May 10 through July 28, 1999, by the Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC), Seattle, Washington. Prior to the 1999 survey, groundfish resources in the GOA had been surveyed by the RACE Division on a triennial schedule with surveys conducted in 1984, 1987, 1990, 1993 and 1996. The triennial surveys covered the continental shelf of the GOA in each of the 5 previous surveys but only included the continental slope in 1984 and 1987. Beginning in 1999, the biennial bottom trawl survey effort in Alaska will alternate between surveys of the GOA shelf and slope in one year followed by surveys of the Aleutian Islands shelf and Bering Sea continental slope the following year. Bering Sea shelf groundfish and crab resources will continue to be surveyed on an annual basis. This report summarizes the general sampling operations and preliminary results of the 1999 GOA shelf and slope bottom trawl survey.

ITINERARY

Survey sampling was conducted aboard the chartered commercial trawlers *Vesteraalen*, *Dominator*, and *Morning Star*. The 75-day survey period from May 10 to July 23 was divided into four legs of 18-19 days each. The *Vesteraalen* charter period was extended an additional five days from July 24 to July 28 to complete stations in the eastern GOA. Sampling operations began near the Islands of Four Mountains (170° W longitude) and extended eastward throughout the GOA on the continental shelf and upper continental slope to Dixon Entrance (132° 30' W longitude). Sampling occurred at pre-selected stations, or nearby alternate stations, in depths ranging from 16 m to 946 m (Figures 1 and 2).

May 10	First day of charter. Load equipment, supplies and sampling gear aboard vessels in Dutch Harbor, AK.
May 10-15	Set up vessels and conduct gear trials.
May 16	Begin sampling survey stations at Islands of Four Mountains.
May 28	Arrive Sand Point, AK. Exchange scientific personnel.
May 29	Begin Leg 2 - Vessels depart Sand Point and resume survey eastward.
June 16	Arrive Kodiak, AK. Exchange scientific personnel.
June 17	Begin Leg 3 - Vessels depart Kodiak and resume survey eastward.

July 6	Arrive Cordova, AK. Exchange scientific personnel.
July 7	Begin Leg 4 - Vessels depart Cordova and resume survey eastward.
July 22	Arrive Ketchikan, AK. Unload vessels.
July 23	Last day of charter for F/V's <i>Dominator</i> and <i>Morning Star</i> .
July 24	F/V <i>Vesteraalen</i> departs Ketchikan to complete survey stations in S.E. Alaska.
July 28	F/V <i>Vesteraalen</i> arrives Ketchikan for unloading.

OBJECTIVES

The primary focus of the biennial groundfish surveys is to build a standardized time series of data designed to assess, describe, and monitor the distribution, abundance, and biological condition of various GOA groundfish stocks. Specific objectives of the 1999 survey were to:

1. Define the distribution and relative abundance of the principal groundfish and invertebrate species inhabiting the Gulf of Alaska;
2. Collect data to define various species-specific biological parameters *i.e.*, age, sex, size, growth rates, length-weight relationships, and feeding habits;
3. Collect integrated net configuration and position data for all trawl hauls to obtain precise area-swept estimates;
4. Record surface-to-bottom water column temperatures; and,
5. Perform special collections as requested by cooperating research groups.

VESSELS AND GEAR

All three charter vessels are house-forward trawlers with stern ramps, multiple net storage reels (mounted forward of the working deck and/or aft over the stern ramp), telescoping deck cranes, propeller nozzles, and paired, controlled-tension hydraulic trawl winches with 1,280 m to 2,190 m of 2.54 cm diameter steel cable. The *Vesteraalen* and *Dominator* are both 38 m in overall length (LOA) and powered by single, 1,700 and 2,000 continuous horsepower (HP) main engines respectively. The *Morning Star* is 45 m LOA and propelled by a 1,700 HP main engine. Each vessel carried a full complement of state-of-the-art navigational and fishing electronics including Global Positioning Systems (GPS) with video position plotters, radars, color video fish-finders, and recording depth sounders. Geographical positioning was further augmented by government supplied military-grade GPS receivers which were used to record time, latitude and longitude along trawl tracklines.

Captain Tim Cosgrove operated the *Vesteraalen* for the entire cruise period. Captain Bill Klopp operated the *Dominator* for the first two

legs followed by Captains Gary Hansen and Craig Jenssen for the third and fourth legs respectively. Captain Jon Edson operated the *Morning Star* for the first two legs followed by Captain Scott Clark for the last two legs.

Standard RACE Division Poly-Nor'eastern high opening bottom trawls, rigged with roller gear, were used exclusively for sampling the selected survey stations. Experimental sampling was conducted with reinforced Poly-Nor'eastern nets equipped with tire gear at sites previously found to be too rugged for the standard roller gear trawl however these data were not used to estimate relative abundance and biomass. Gear specifications of the standard trawl included: a 27.2 m headrope with twenty-one 30 cm diameter floats, and a 24.3 m, 1.3 cm diameter longlink alloy chain "fishing line" attached to a 24.9 m, 0.95 cm diameter 6 x 19 galvanized steel wire footrope. The roller gear was 24.2 m long and constructed of 1.9 cm diameter 6 x 19 galvanized steel wire rope and 36 cm rubber bobbins separated by a solid string of 10 cm rubber disks. In addition, 5.9 m wire rope extensions with 10 cm and 20 cm rubber disks were used to span each lower flying wing section. The fishing dimensions of the trawls were measured using Scanmar¹ acoustic net mensuration equipment.

Survey trawls were constructed of 12.7 cm stretched-mesh polyethylene web with a 3.2 cm stretched-mesh nylon liner in the codend. Net rigging consisted of triple 54.9 m, 1.6 cm diameter galvanized wire rope dandylines. Chain extensions to the dandylines were 46 cm and 23 cm at the headrope and side panel attachments, respectively. Steel V-doors with dimensions of 1.83 x 2.74 m, and weighing approximately 800 kg each were used to open the net.

SURVEY AREA

The GOA biennial survey area is dominated by the continental shelf (depths to 200 m) which is crossed by numerous gullies or troughs, some as deep as 300 m. The continental shelf represents approximately 71% of the 319,884 km² survey area with associated gullies representing an additional 17%. The width of the shelf area varies from approximately 18.5 km in the Unalaska Island- Islands of Four Mountains region to 185 km off the Kenai Peninsula (Figures 1 and 2). Irregular bathymetric features along with an extensive and complex shoreline region, provide a rich diversity of habitat types for many juvenile and adult groundfish such as walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), juvenile sablefish (*Anoplopoma fimbria*), a wide variety of flatfish species including Pacific halibut (*Hippoglossus stenolepis*), rockfish species such as Pacific ocean perch (*Sebastes alutus*), and many invertebrates including several commercial crab species, scallops, and pandalid shrimp.

The continental slope (excluding major gullies) between the depths of 200 m and 1,000 m represents approximately 12% of the survey area.

¹ Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Often steep and rugged, the slope region provides habitat for species such as rougheye and shortraker rockfishes (*Sebastes aleutianus* and *S. borealis*), adult sablefish, shortspine thornyheads (*Sebastolobus alascanus*), Dover sole (*Microstomus pacificus*) and grenadiers (Macrouridae).

SURVEY DESIGN AND METHODS

The GOA survey region was divided into 59 strata based on bathymetry, major geographic features, and International North Pacific Fishery Commission (INPFC) regulatory areas. Strata range from near-shore areas adjacent to coastlines on the continental shelf to 1,000 m depths on the upper continental slope.

As in past years, a stratified random survey design was employed in the 1999 biennial survey. A modified Neyman optimum allocation strategy based on data from the 1990, 1993 and 1996 triennial surveys was used to allocate effort between strata. Neyman optimum allocation calculations were made for each of the principal groundfish species in each survey year based on that year's survey data and the estimated time to perform a tow in a given stratum as the cost variable (deeper tows take longer to execute, therefore cost more). A mean of the resulting proportions was then calculated, resulting in an estimate of optimal allocation for each of the principal groundfish species. A weighted mean of these values was then calculated using each species' mean biomass as the weighting variable. Within each major depth interval (1-100 m, 101-200 m, etc.), the number of stations was then summed resulting in an optimal allocation between depth intervals. This number of tows was then reallocated between strata, proportional to the area of each stratum so that the sampling density was constant within each depth interval throughout the survey area.

The target duration for on bottom time for a standard trawl haul was 15 minutes. Trawling time on bottom was estimated during the tow using real-time net configuration data (wingspread and headrope height) acoustically transmitted to the vessel. GPS data were collected every two seconds throughout the tow. Temperature and depth were recorded every six seconds by a bathythermograph attached to the trawl headrope. A bottom contact device, based on a tilt sensor attached to the fishing line to detect contact with the bottom, collected data every six seconds. The final tow durations, start and end times and geographical positions were estimated from all information collected from each tow.

The operational guidelines for completing a standard survey tow were:

1. 15 minutes towing time (distance fished approximately 0.74 nm or 1.4 km at a speed of approximately 3 knots).
2. Appropriate towing wire deployed as specified in the scope table. The goal of each tow was to not exceed 10 m of depth change over the 15 minute towing period. In areas where this was not possible, trawl warp was adjusted during the tow to reflect the changing depth.

3. Net mensuration indicates fishing gear operating within normal limits of 16 m between trawl wingtips and 6.8 m headrope height taking into account that the net width tends to increase and net height decreases with increased amount of deployed cable.

4. Survey gear in continuous contact with the bottom.

5. No hang ups, gear damage or gear conflicts (e.g. crab pots).

Catches were sorted to species, weighed and enumerated according to standard AFSC and RACE Division protocol. Extensive size composition data were collected with barcode based recording devices and downloaded to computer database files after each tow. A variety of biological data including age structures (mostly otoliths), lengths, and weights of individual specimens were collected and entered in the computer database.

Special collections completed in cooperation with other research units, agencies and educational institutions included:

- Tissue samples from selected rockfish species (*Sebastes*) and lingcod (*Ophiodon elongatus*) to examine stock structure and population genetics (AFSC, Auke Bay Laboratory).
- Heart samples from Pacific ocean perch, northern rockfish (*Sebastes borealis*) and rougheye rockfish as part of a coast-wide genetic study (AFSC, Auke Bay Laboratory).
- Egg-masses deposited by bigmouth sculpins (*Hemitripterus bolini*) to augment early life history development studies (AFSC, RACE Division).
- Crustacean specimens of the genus *Argulus* which typically parasitize various groundfish and salmon species (Southern Illinois University).
- Snailfishes (*Liparidinae*), lumpsuckers (*Cyclopterinae*) and popeye grenadiers (*Coryphaenoides cinereus*) for species identification verification and other special studies (AFSC, RACE Division).
- Spiral intestines from *Bathyraja* and *Raja* skates for parasite studies (University of Connecticut).
- Stomachs of major groundfish species (AFSC, Resource Ecology and Ecosystem Modeling Program).

RESULTS

Sampling proceeded from west to east. In the Shumagin and Southeastern INPFC areas, an equal number of stations from each stratum were randomly assigned to each of the three vessels after accounting for tows deeper than 700 m being sampled exclusively by the *Morning Star* and stations between 500 m and 700 m being sampled equally by the *Morning Star* and *Dominator*. Stations in the Chirikof, Kodiak and Yakutat INPFC areas

were assigned to minimize the running time between stations for each vessel. Some pre-assigned stations were not sampled due to unsuitable bottom conditions. In cases where trawlable bottom could not be found at a given station, a pre-selected alternate location was sampled. Of the 832 attempted standard survey tows, 764 tows were successfully completed ranging in depth from 16 m to 946 m.

Sea surface temperatures and bathythermograph recordings were collected at nearly every trawl site. The average sea surface temperature for the entire survey period was 8.0° C with temperatures increasing from 4.1° C in May, to 7.1° C in June and 11.5° C in July. The mean bottom temperature for the survey period was 5.1° C with temperatures increasing from an average of 3.6° C in May to 5.0° C in June and 5.8° C in July. Bottom temperatures decreased with increasing depth from 5.2° C at depths shallower than 100 m to 3.2° C between 900 and 1,000 m of bottom depth.

Summarized total catch data indicate that arrowtooth flounder (*Atheresthes stomias*), Pacific ocean perch, Pacific halibut, walleye pollock and giant grenadiers (*Albatrossia pectoralis*) were the dominant species in trawl catches (Table 1) representing a combined 63 percent of the 338,932 kg total survey catch. Pollock, with 10 percent of the total survey catch, was most abundant in the Western Gulf where it comprised 30 percent of the catch. Pollock abundance declined sharply in the Central and Eastern Gulf representing only 4 percent of the survey catch of each area. Arrowtooth flounder, the most abundant species in the survey, accounted for 22 percent of the total survey catch and ranked 2nd in the Western GOA and 1st in the Central and Eastern GOA. Pacific ocean perch representing 12 percent of the total survey catch ranked 6th in the Western GOA, and 2nd in the Central and Eastern Gulf. Pacific halibut with 10 percent of the total catch ranked 4th, 3rd and 5th in the Western, Central and Eastern Gulf areas. Pacific cod with 5% of the survey catch ranked 5th and 6th in the Western and Central Gulf and 14th in the Eastern Gulf.

Throughout the survey, biological data were collected from a wide variety of species (Table 2) with length measurements being the most common. Nearly 219,000 fish representing 74 species were measured for length including approximately 56,000 arrowtooth flounder, 24,000 pollock, 18,000 shortspine thornyheads, 16,000 flathead sole, 13,000 Pacific ocean perch and 12,000 Rex sole (Table 2). Approximately 11,000 otoliths were collected from 22 species along with 12,000 length-weight observations representing 39 species. In addition, over 2,400 stomach samples were collected from four major predator species: arrowtooth flounder, Pacific cod, Pacific halibut, and walleye pollock.

Scientific Staff and Affiliations for the 1999 Gulf of Alaska Biennial Groundfish Assessment Survey

	<u>Leg 1</u>	<u>Leg 2</u>	<u>Leg 3</u>	<u>Leg 4</u>
Dominator	Eric Brown¹ Robin Harrison Nate Raring Mark Nelson ² Roger Clark Elaina Jorgensen	Eric Brown Dennis Benjamin H. MacConnell ⁵ Elaina Jorgensen Cassie Hayes Roger Clark	Bill Flerx Mark Wilkins Ron Dotson ⁷ Cassie Hayes Geana Tyler ² Amy Hays ⁷	Michael Martin Scott McKillip Larry Haaga Roger Clark Chris Lunsford ⁵ Dean Courtney ⁵
Vesteraalen	Skip Zenger Frank Shaw Jim Stark Paul Von Szalay Scott Casey ³ Brian Frye ⁴	Mark Zimmermann Lyle Britt Sarah Gaichas ² Carla Currens ⁶ Scott Casey ³ Linc Freese ⁵	Ken Weinberg Bob Lauth Elaina Jorgensen Lyle Britt Chris Johnston ² Hillary Emberton ³	Jay Orr Bill Flerx Ron Dotson ⁷ Lisa Britt Jim Stark Hillary Emberton ³
Morning Star	Bill Flerx Ron Payne Gary Mundell Shane Capron ⁵ Chris Mah ⁴ Mike MacEwan	Bob Lauth Jay Orr Ron Erickson Nate Raring Joe O'Malley Paul Spencer ²	Michael Martin Skip Zenger Nate Raring Paul Von Szalay Bill Rugen Mike MacEwan	Robin Harrison Dave Clausen ⁵ Delsa Andrel ² Steve Syrjala Bob Van Syoc ⁴ Kate Shaw ⁸

1. Resource Assessment Conservation Engineering Division (RACE) employee unless otherwise indicated

2. Resource Ecology Fisheries Management Division, Alaska Fisheries Science Center, Seattle, WA.

3. International Pacific Halibut Commission, Seattle, WA.

4. California Academy of Sciences, San Francisco, CA.

5. Auke Bay Laboratory, Auke Bay, AK.

6. Visiting Scientist, University of South Carolina

7. Southwest Fisheries Science Center, La Jolla, CA.

8. Visiting Scientist, University of Kansas

An additional 5-day extension was conducted by the Vesteraalen. Scientific staff included Michael Martin as FPC, Robin Harrison, Paul Von Szalay, Roger Clark and Mike MacEwan.